Operating and Service Manual

HP 86205A Directional Bridge

SERIAL NUMBERS

This manual applies to HP 86205A bridges with serial number 3140A00101 and above. For additional information concerning serial numbers, see "Instruments Covered by this Manual" in "General Information."

HEWLETT PACKARD

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General Information

Manual Overview

This manual contains information for operating, testing, and servicing the HP 86205A bridge.

Product Description

The HP 86205A is a high performance 50Ω directional bridge designed for high quality reflection measurements and external source leveling applications over an RF frequency range of 300 kHz to 6 GHz. The bridge achieves a low through loss of 1.5 dB and a high coupling factor of 16 dB. These characteristics make it useful in applications requiring directional couplers, such as power monitoring and closed-loop leveling applications.

Instruments Covered By This Manual

Each bridge has a unique serial number. The contents of this manual apply directly to bridges with serial numbers listed on the title page.

Accessories

Table 5-1 lists accessories available for use with these bridges.

Specifications & Supplemental Characteristics

Table 1-1 lists bridge specifications, which are the performance standards or limits against which you can test the device.

Table 1-2 lists supplemental (typical, non-warranted) bridge characteristics.

Table 1-1. HP 86205A Specifications

Connector:	50Ω Precision Type-N female	**Port Match:**	
Frequency Range:	300 kHz to 6 GHz	>23 dB	300 kHz to 2 GHz
Directivity:	25 ±5°C	>20 dB	2 to 3 GHz
>30 dB	300 kHz to 5 MHz	>18 dB typical	3 to 5 GHz
>40 dB	5 MHz to 2 GHz	>16 dB typical	5 to 6 GHz
>30 dB	2 GHz to 3 GHz		
>20 dB typical	3 to 5 GHz		
>16 dB typical	5 to 6 GHz		

Table 1-2. HP 86205A Supplemental Characteristics

Nominal Through Loss:		**Max Input Power:**	+25 dBm
1.5 dB +0.1 dB/GHz		**Max Input Voltage:**	
Through Loss Deviation:		30 VDC	port 1 or port 2
±0.2 dB from nominal		0 VDC	port 3
Nominal Coupling Factor:		**Max Input Current:**	1 amp DC
16 dB +0.15 dB/GHz	1 MHz to 3 GHz	**Connector Recession:**[1]	0.204 in to 0.207 in^2
16.5 dB -0.2 dB/GHz	3 GHz to 6 GHz	**Weight:**	
Coupling Factor Deviation:		0.57 kg (1.3 lbs)	net
±0.2 dB from nominal	1 MHz to 3 GHz	1.80 kg (4.0 lbx)	shipping
±0.4 dB from nominal	3 GHz to 6 GHz	**Dimensions:**	
			160W x 93H x 23D (mm)
			6.3W x 3.7H x 1D (in)

1 Recession refers to a female type-N connector center conductor dimension relative to 0.207 nominal offset.

2 Before you performance test an HP 86205A bridge, gage all the connectors and enter the results in the test record at the end of "Performance Tests." For descriptive illustrations defining connector tolerances, see the *Microwave Connector Care Manual* (HP part number 08510-90064).

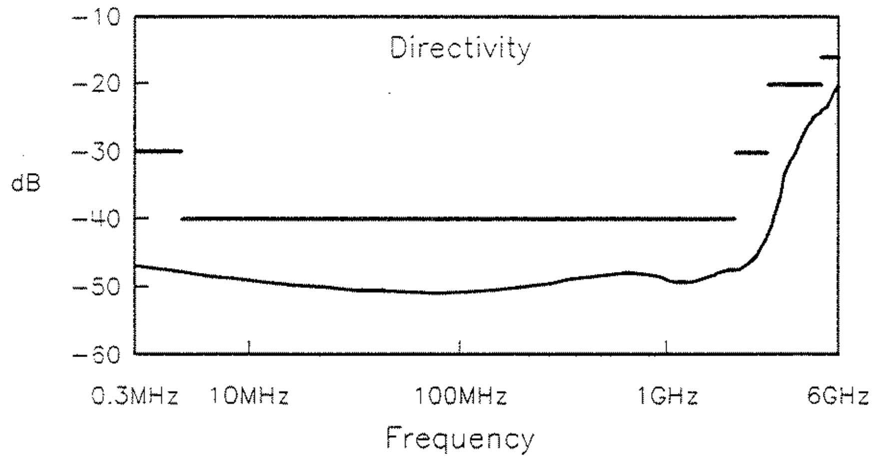

Figure 1-1. Example Plot of HP 86205A Directivity

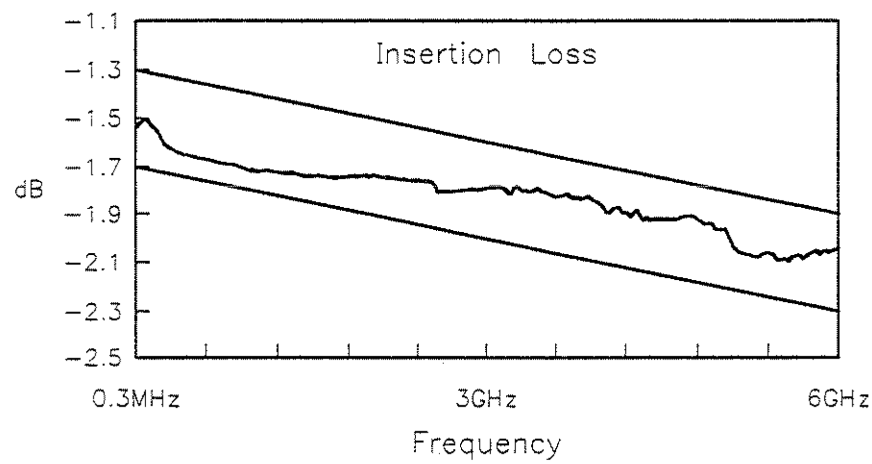

Figure 1-2. Example Plot of HP 86205A Insertion Loss

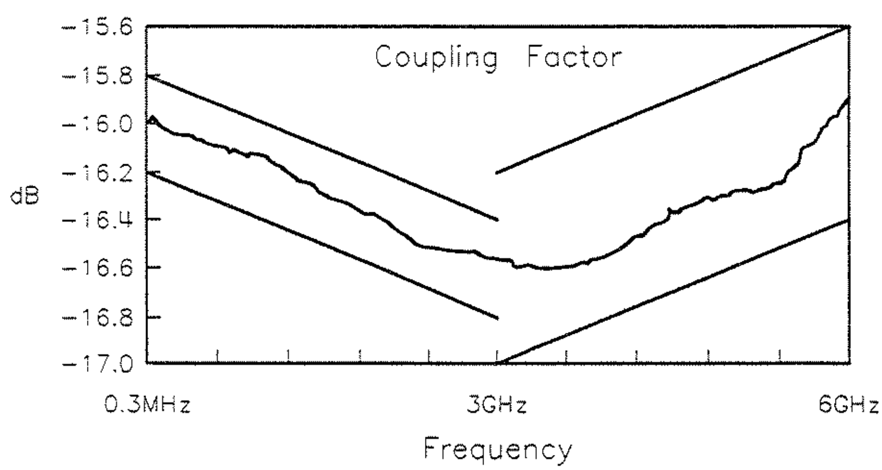

Figure 1-3. Example Plot of HP 86205A Coupling Factor

Initial Inspection

1. Check the shipping container and packaging material for damage.
2. Check the shipment for completeness.
3. Check the connectors and bridge body for mechanical damage.
4. Check the bridge electrically.

   Refer to the "Performance Tests" chapter for procedures that check the bridge electrically.

If any of the following conditions exist, notify your nearest Hewlett-Packard office:

- incomplete shipment
- mechanical damage or defect
- failed electrical test

If you find damage or signs of stress to the shipping container or the cushioning material, keep them for the carrier's inspection. Hewlett-Packard does not wait for a claim settlement before arranging for repair or replacement.

2

Operation

Overview

This chapter includes the following information on the HP 86205A directional bridge:

- bridge operation
- bridge features
- operating precautions
- measurement configurations

Bridge Operation

Table 2-1 and Figure 2-1 illustrate the bridge operation. The table shows the port orientation in a reflection measurement and in a power monitoring or leveling configuration. The figure identifies the paths and ports of the bridge and shows the electrical characteristics of each path.

Table 2-1. Port Orientation with Corresponding Application

Port Number	Application	
	Reflection Measurement	Power Monitoring/Leveling
1	Test Port	Input
2	Input Port	Output
3	Coupled	Coupled
		Level

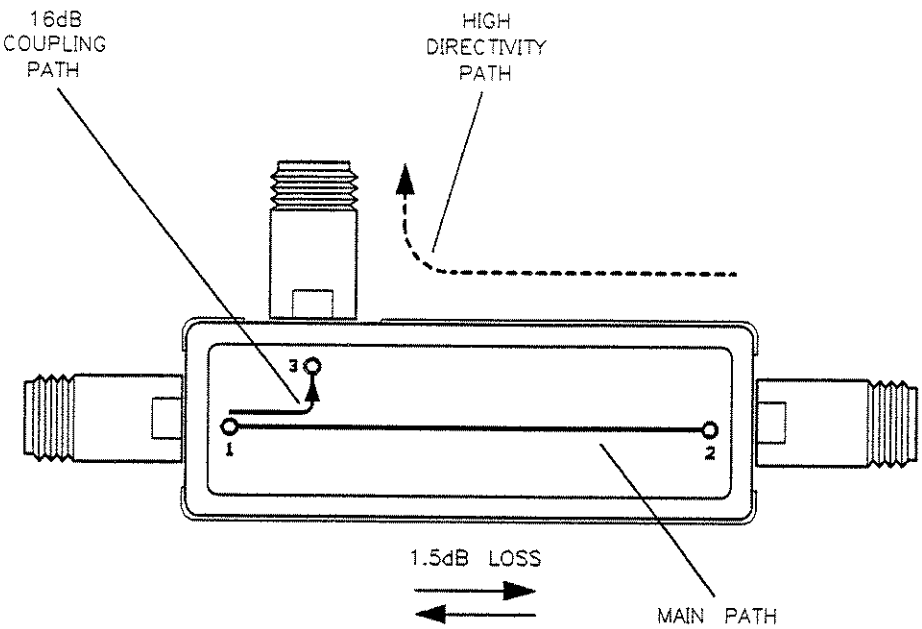

Figure 2-1. HP 86205A Bridge Ports and Measurement Paths

Bridge Features

- frequency range from 300 kHz to 6 GHz
- high directivity
- insertion loss of 1.5 dB (nominal)
- coupled arm flatness of ±0.2 dB from nominal

The HP 86205A operates over an RF frequency range of 300 kHz to 6 GHz and has excellent directivity for high quality reflection measurements. Additionally, the bridge has a very low insertion loss of 1.5 dB which means more power to the device under test; this is especially important in the measurement of high power solid state amplifiers and TWTs. The bridge also features a ±0.2 dB flatness from the nominal 16 dB coupled arm. This capability is valuable in external leveling applications where a power meter or diode detector is used to level the power remotely from the source. Power variations are then minimized, which is important when measuring input-sensitive devices.

DC bias may be applied to a DUT through the main arm of the bridge. (**DO NOT** apply bias to the coupled port of the bridge.)

Threaded mounting holes (3.5 mm x 0.5 mm) are located under prepunched holes in the model number label, as shown in

Figure 2-2. Since the bridge package is brass, appropriate caution must be taken to avoid damaging the threaded holes.

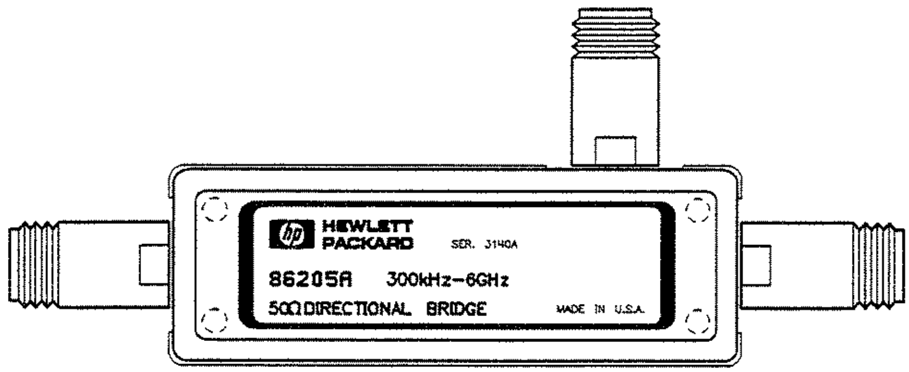

Figure 2-2. Location of Threaded Mounting Holes

Operating Precautions

- Read and observe all cautions.
- Tighten the bridge connectors with fingers only.
- If you must use a wrench, use a torque wrench set at 9.2 cm-kg (12 lb-in).

Cautions

Electrostatic discharge (ESD) can damage the highly sensitive microcircuits in this device; an ESD as low as 1000V can destroy your bridge.

ESD damage occurs most often as you connect or disconnect a device. Use the bridge at a static-safe workstation and wear a grounding strap. *Never* touch the input connector center contacts, or the contact pins of a connecting cable.

Do *not* apply more than +25 dBm RF CW power, or more than 1 amp DC or 0 VDC to port 3 or 30 VDC to port 1 or 2 of the bridge. Higher current/power/voltage can electrically damage the bridge.

Before you connect a cable to the bridge, always discharge the cable's center conductor static electricity to instrument-ground.

Do not drop the bridge or subject it to mechanical shock.

Measurement Configurations

This section shows the HP 86205A directional bridge in the following configurations:

- remote reflection measurement using the HP 8711 network analyzer
- vector impedance measurement using two bridges and the HP 8753 network analyzer
- external power leveling with or without a controller
- reflection measurement using a spectrum analyzer and tracking generator

Remote Reflection Measurement Configuration

You can use remote sensing in applications where your DUT is not easily accessable. For example: when measuring the reflection coefficient of an antenna that is located on a tower.

To Set Up the Measurement

1. Connect the equipment as shown in Figure 2-3.

Note

The cable length from the analyzer source to the bridge does not affect directivity, but may affect source match. However, you may put an attenuator between the cable and bridge to improve source match.

Connect the DUT either directly to the bridge or as close as possible.

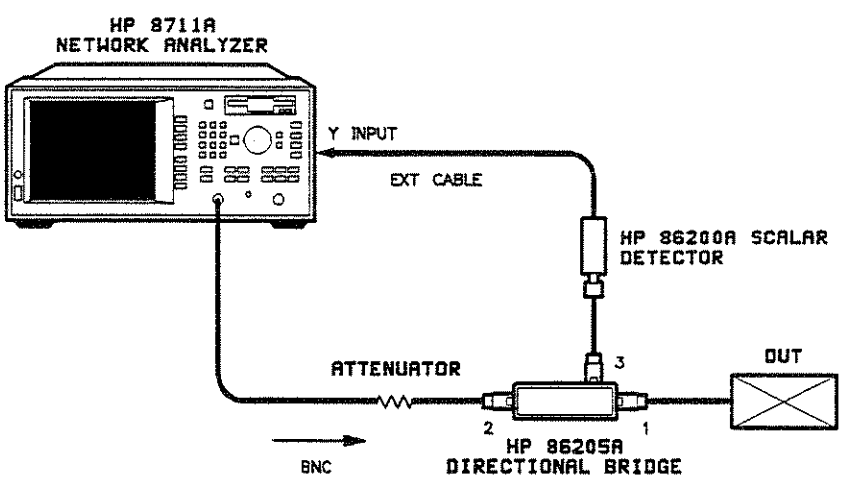

Figure 2-3. Remote Directivity Measurement Setup

2. Set the parameters on the analyzer to measure with an external detector by pressing:

   (CHAN 1) `Det Options` `Broadband External` `Y/R*`

3. With nothing connected to the bridge, make a normalization of the measurement setup by pressing:

   (CAL) `Normalize`

4. Connect the DUT to the bridge and adjust the scale/division under the (DISPLAY) key.

Vector Impedance Measurement Configuration

This configuration provides a low-cost custom test system when full 2-port measurements are not needed.

To Set Up the Measurement

1. Connect the equipment as shown in Figure 2-4

Note

You may connect the analyzer input signal to either the A or B input port. Use an A/R or B/R ratio measurement to improve the source match.

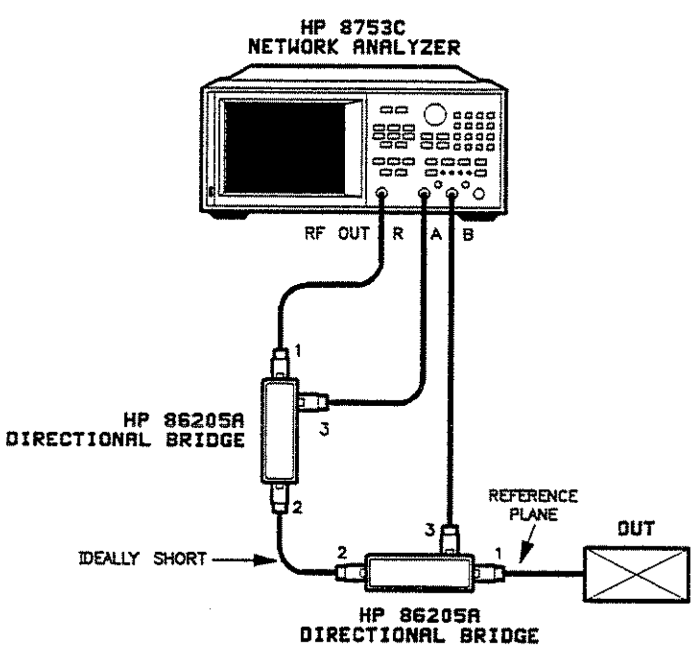

Figure 2-4. Vector Impedance Measurement Setup

2. Choose the following parameters on the analyzer:

   (PRESET)
   (MEAS) A/R (or B/R if you connected the analyzer input signal to the B input port)
   (MENU) POWER then enter the power value and press (x1)
   NUMBER OF POINTS then enter the desired number
   (START) then enter the start frequency and press (x1)
   (STOP) then enter the stop frequency and press (x1)

3. Make a measurement calibration by pressing one of the following key sequences:

   (CAL)
   Cal Kit N 50Ω
   Return Calibrate menu
   RESPONSE connect *either* an open *or* short calibration device to the reference plane and press the corresponding OPEN (F) or SHORT (F) key.

   or

   (CAL) Calibrate Menu
   (for A/R) S11 1-PORT
   (for B/R) S22 1-PORT

   Connect an open, short, and load calibration device to the reference plane while pressing the corresponding key for measurement.

4. Connect the DUT to the reference plane and adjust the scale/division under the (SCALE REF) key.

External Power Leveling Configuration

The measurement configuration shown in Figure 2-5 provides precision power levels to a remote DUT. With a power meter and bridge, the source power can be monitored and automatically adjusted.

The HP 8753 and HP 8625 sources can alternatively be used in this automated measurement configuration.

By substituting a frequency counter for the power meter, this configuration can be used for signal monitoring.

To Set Up the Measurement

1. Connect the equipment as shown in Figure 2-5.

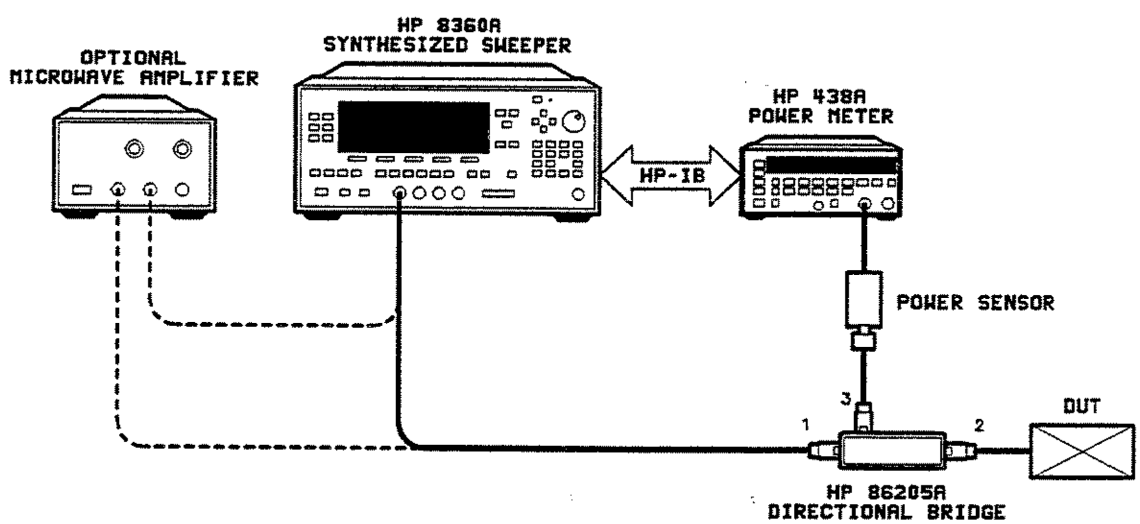

Figure 2-5. External Power Leveling Configuration

2. Zero and calibrate the power meter/sensor.
3. Enter the appropriate power sensor calibration factors into the power meter. (Can only be done with an HP 438A or 437B.)
4. Enable the power meter/sensor cal factor array. For operating information on the power meter refer to its operating manual.
5. Connect the power sensor to the bridge as shown in Figure 2-5.
6. Set up the synthesizer parameters by pressing:

(PRESET)
(START) then enter the desired start frequency
(STOP) then enter the desired stop frequency

7. Set up the user flatness correction by pressing:

   (MENU) Fltness Menu
   Delete Menu Delete All
   (PRIOR)
   Auto Fill Start and enter the desired start frequency
   Auto Fill Stop and enter the desired stop frequency
   Auto Fill Incr and enter the desired increment frequency value

8. Set the power meter under synthesizer control to perform the sequence of steps necessary to generate the correction information at each frequency point by pressing:

   Mtr Meas Menu Measure Corr All

9. When a message is displayed, indicating the operation is complete, apply the flatness correction array to your measurement setup by pressing:

   (FLTNESS ON/OFF) (the amber LED should be on)

   The power produced at the point where the power meter/sensor was disconnected is now calibrated at the frequencies and power level specified above.

10. On the HP 8360, press:

    (ALC) Leveling Point ExtDet

11. Set the coupling factor by pressing:

    Coupling Factor (−14.5) (dB(m))

Note

The 16 dB coupling factor is partially compensated by the through loss (1.5 dB) to give a 14.5 dB effective coupling factor (relative to the bridge output port).

The bridge coupling flatness has as good as 0.1 dB/GHz power level roll-off with <±0.2 dB error.

Reflection Measurement Configuration

This configuration is for portable reflection measurement applications.

To Set Up the Measurement

1. Connect the equipment as shown in Figure 2-6.

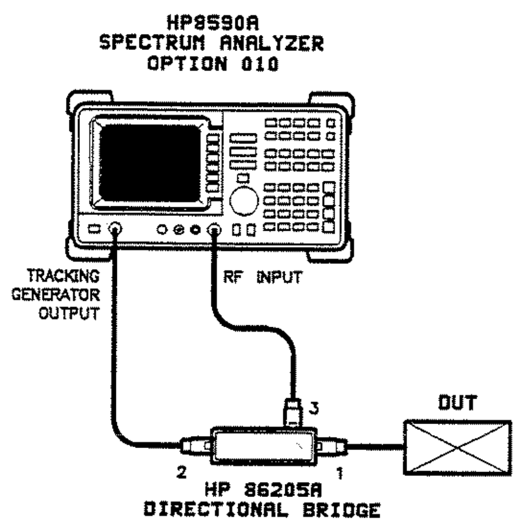

Figure 2-6. Reflection Measurement Setup

2. On the tracking generator, press:

   (AUX CTRL)
   TRACK GEN SRC PWR ON

3. Set the desired center frequency and span to view the DUT.
4. Replace the DUT with a short circuit.
5. Normalize the trace by pressing:

   (TRACE)
   TRACE B CLEAR WRITE B
   BLANK B MORE 1 OF 3 NORMALIZE ON

   The normalized trace or flat line represents 0 dB return loss.

6. Measure the DUT by connecting it to port 1 of the bridge.

   Terminate the second port of a two-port DUT.

7. Press (MKR) and position the marker with the front panel knob to measure the return loss at the frequency of interest.